



**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY**  
**REGION 6**  
**1201 ELM STREET, SUITE 500**  
**DALLAS, TEXAS 75270**

**MEMORANDUM**

**SUBJECT:** Request to Conduct an Engineering Evaluation/Cost Analysis for the Tronox Navajo Area Uranium Mine Sections 32 and 33 Mines Site, McKinley County, New Mexico

**FROM:** Warren Zehner, On-Scene Coordinator  
CERCLA & Oil Removal Section (SEDEC)

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**THRU:** Craig Carroll, Chief  
Emergency Management Branch (SEDE)

**TO:** Wren Stenger, Director  
Superfund and Emergency Management Division (SED)  
U.S. Environmental Protection Agency Region 6

Will C. Duncan III, Assistant Director  
Superfund and Emergency Management Division (SED)  
U.S. Environmental Protection Agency Region 9

**I. PURPOSE**

The purpose of this Approval Memorandum is to request and document approval to conduct an engineering evaluation/cost analysis (EE/CA) for a non-time critical removal action for the Tronox Navajo Area Uranium Mines (NAUM) Sections 32 and 33 Mines Site (Site), in the Smith Lake Mining Sub-district (SLSD) of the Grants Mining District (GMD), McKinley County, New Mexico.

The proposed EE/CA for this Site is expected to be an EPA-lead action utilizing funding for the Section 32 and Section 33 NAUMs identified in the Tronox settlement (In re: TRONOX Incorporated, et al, Case No. 09-10156 (Bankruptcy, S.D.N.Y)). The EE/CA document will be prepared in accordance with applicable laws, regulations, and EPA policy and guidance.

This action meets the criteria for initiating a removal action under the National Contingency Plan (NCP), 40 C.F.R. § 300.415.

This is a cross-boundary site, an area of contamination located partly on private land in New Mexico under the jurisdiction of EPA Region 6 (Section 33) and partly on adjacent Navajo allotment land under the jurisdiction of EPA Region 9 (Section 32). In accordance with the NCP requirements for multi-regional responses, 40 CFR § 300.140, EPA Region 6 and EPA Region 9 are working in conjunction at this Site. EPA Region 9 performed a Time Critical Removal Action on the Section 32 Mine in 2012. In accordance with the 40 CFR § 300.140, EPA Region 6 is designated as the lead for this Site and will



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provide the On-Scene Coordinator (OSC) for Non-Time Critical Removal Actions resulting from the EE/CA.

Pursuant to the Tronox Settlement Agreements, U.S. EPA Region 6 & 9 have conducted investigations at the Sites, which have identified surface soil and near-surface soil conditions that indicate that a non-time critical removal action (NTCRA) is warranted to reduce or eliminate threats to human health and the environment to protective levels. At this time, the Sites are not proposed for the CERCLA National Priorities List, 40 CFR Part 300, Appendix B.

## **II. SITE CONDITIONS AND BACKGROUND**

CERCLIS ID: NMN000605483

Site ID: A6QC/09XN

Latitude: 35.490610

Longitude: -108.016627

### **A. Site Location**

The Tronox NAUM Sections 32 and 33 Mines Site is located in Sections 32 and 33, Township 15 North, Range 11 West in the Smith Lake Sub-District (SLSD) of the GMD, approximately nine miles north of Prewitt, in McKinley County, New Mexico. The GMD is an area of significant uranium-bearing formations encompassing several hundred square miles in northwestern New Mexico (Attachments 1 and 2).

The Tronox NAUM Sections 32-33 Mines Site is composed of two abandoned uranium mining operations formerly owned and/or operated by Kerr McGee (aka Kermac Nuclear Fuel Corporation), identified for response in the Tronox settlement. Based on limited historical data, it appears that these mines were initially one mine called the Moe #5. The initial shaft was reportedly located on Section 33 and mining followed the ore in a decline onto Section 32 where mining operations continued. While the Site operated physically as a single mine, it was later described as two distinct mines in a cross-boundary location. EPA Region 9 conducted a removal assessment in 2009 and an interim removal action on portions of Section 32 in 2012. (See Section II.B., Site Description).

The Section 32 mine is located on Indian Allotment land which is a part of the Casamero Lake Chapter of the Navajo Nation. Section 33 is privately owned property. The Site area lies approximately 7,000 to 7,200 feet in elevation above mean sea level. Access to the Section 32 mine requires permission from the allottees in coordination with the Bureau of Indian Affairs. Access to Section 33 requires permission from the private landowner.

Although the Section 32 and 33 mines were identified separately in the Tronox settlement, for purposes of the removal site evaluation (RSE) and this EE/CA, the EPA is addressing them as one Site, as they present a single area of contiguous contamination. In the RSE, the total surface area exceeding the radiological Removal Action Level (RAL) was estimated to be 949,483 square feet or 22 acres. The Site is characterized by dry plains, mesas, valleys, and canyons formed from sedimentary rocks. It supports arid and semi-arid grasslands, shrub/scrub zones, savannas, and woodlands. Current area land use of the Site is cattle ranching.

## **B. Site Description**

As noted above, the Site is a contiguous area of contamination crossing over EPA regional boundaries, located partly on private land (Section 33) within the jurisdiction of EPA Region 6 and partly on Navajo tribal allotment land within the jurisdiction of EPA Region 9 (Section 32). The Section 32 and Section 33 Mines had underground workings in both Section 32 and Section 33, and shared two shafts, surface structures, and infrastructure. The Sections 32 and 33 Mines Site is referred to as the single Moe Mine or Moe #5 Mine on some historical maps and documents. An additional shaft was located approximately 1300 feet south of the main shaft, in an area referred to as the transfer area.

There is limited historical data available for these mines. The Section 32-33 Mines were developed and operated by Kerr McGee from 1960 through 1969. The Section 32 Mine operated from 1960 through 1969 and produced 20,117 tons of ore. The Section 33 Mine operated from 1960 through 1964 and produced 4,243 tons of ore. (See Attachment 3). The mines were “dry mines”, i.e. above the water table, and did not require water to be pumped out in order to reach the ore body. The most recent operator of the Section 32-33 Mines is reported to be Cobb Nuclear Company. The mines have undergone some reclamation activities under the New Mexico Mining and Minerals Division (NM MMD). The buildings and aboveground structures have been removed, presumably by the owners or the operators. No official reclamation records were located.

In 2009, EPA Region 9 conducted a visit to the mine areas on Sections 32 and 33 as part of the Navajo Abandoned Uranium Mine Site Screening initiative. EPA observed piles of mine waste materials, an unsecured open shaft, and no above-ground buildings. EPA noted elevated gamma readings up to ten times background near the open shaft and the waste piles. There were reportedly four residents living adjacent to the mine waste piles on Section 32, raising livestock. There were no residents and limited livestock (cattle) on Section 33.

In June-July 2012, EPA Region 9 conducted a Removal Assessment (RA) of the areas associated with the visible mining footprint. The RA delineated excess gamma contamination near the mine waste piles in Sections 32 and 33, the shaft at the border of Sections 32 and 33, and a uranium ore transfer area located in Section 32. The background Ra-226 concentration for the soil samples was 1.2 picocuries per gram (pCi/g). The highest Ra-226 soil concentration in Section 32 was 37.3 pCi/g. The highest soil concentration of Ra-226 in Section 33 was 76.1 pCi/g. These concentrations far exceeded the removal threshold of approximately 2.5 pCi/g.

In October-November 2012, EPA Region 9 conducted a Time-critical Removal Action (TCRA) at areas of the Site delineated earlier in 2012, based on visible impacts of mining. This TCRA was limited to areas previously delineated within Section 32; the owner of Section 33 denied access to EPA. EPA Region 9 excavated contaminated soils from the mine area and the transfer area in Section 32. During excavation, EPA discovered two additional mine shafts associated with the mining activities on Section 32. The three mine shafts were sealed and covered over with fill material. Soil removed from the excavated areas was placed in Section 32 in an interim stockpile, designed by the EPA national Environmental Response Team (ERT). After excavated materials from all planned removal areas were placed on the stockpile, a soil stabilizer and dust control agent was applied. The stockpile occupies an area of 121,840 square feet and has a height of 30 feet above the surrounding ground surface. The stockpile was secured with a chain link fence. Excavated areas were graded and contoured to blend with the overall topography and drainage course of the area. (See Attachment 4)

### C. Site Ownership

As stated above, the mines included in this Site are located in Sections 32 and 33, Township 15 North, and Range 11 West in the SLSD of the GMD, approximately nine miles north of Prewitt, in McKinley County, New Mexico. Section 32 is Indian Allotment land, part of the Casamero Lake Chapter of the Navajo Nation. Section 33 is privately owned property.

## III. NATURE AND EXTENT OF CONTAMINATION

### A. EPA Removal Site Evaluation

As discussed in Section II. A of this document above, EPA Region 9 conducted a limited RA and TCRA on this Site in 2012 to address the visible contamination associated with the mine on Section 32, containing the waste in a designed and secured interim stockpile (See Attachments 4 and 5). These actions were completed prior to the Tronox NAUM settlement. Since these mines were listed in the Tronox NAUM settlement, the EPA revisited them to conduct a more comprehensive RSE in order to be consistent in approach with other Tronox mines. The RSE evaluated the potential mine-related excess gamma radiation present on the entire Sections, in addition to assessing soil metals concentrations. The EE/CA process will evaluate alternatives for a final remedy for the stockpiled waste on Section 32 and the unconsolidated mine waste on Section 33 and other Site wastes above health-based levels.

The Sections 32 and 33 Mines RSE consisted generally of a complete Section wide-scale gamma radiation scanning survey using field instruments to collect real-time measurements and a more focused collection of surface and sub-surface soil samples for laboratory analysis of site contaminants of potential concern. The site mining history, previous investigations, contaminant background levels, theoretical and empirical correlations of field gamma scan survey measurements to contaminant concentrations, and comparison of site data to appropriate soil screening levels and risk-based exposure modeling results all guided a determination of the extent of contamination due to historic uranium mining activities. The RSE was focused primarily on radiological contamination, but also evaluated Target Analyte List (TAL) metals plus uranium (chemical toxicity) contamination, given the historic mining of metals in addition to uranium in the near vicinity of the SLSD. In general, the conclusions of the RSE are:

- Recent gamma radiation scanning survey of soils around residential areas suggests no need for further action in that area because it is within the Site-specific risk range.
- Surface concentrations for Ra-226 exceeded the Site-specific range at areas of Site associated with historic mining activities (ie. Mine openings, haul roads, etc.).
- The Site poses no mining-related physical hazard as shafts, vent holes and above ground workings have been covered and/or removed per NM MMD requirements.
- U-238 and its decay-chain progeny were identified as a contaminant of potential concern (COPC). Ra-226 was chosen as the most appropriate progeny for which a risk-based RAL of 3.0 pCi/g was established, which is equivalent to a total cancer morbidity risk of  $2.1 \times 10^{-4}$ . The RAL was established under the assumption of U-238 and its decay-chain progeny in equilibrium; that is, the radioactivity concentrations of U-238 and each progeny are statistically equal.
- The lateral and vertical extent of contamination above the established action level for Ra-226 was well characterized and documented.

- The delineation of contamination in Section 32 followed a drainage path from the waste stockpile westward. In the west half of the section, the contamination followed a straight line that coincides with an old road that was used to haul ore from the mine. In Section 33, the only mine-related radioactive contamination is within the fenced mine footprint.
- No TAL metals or uranium (chemical toxicity) were identified as a COPC.

The primary contaminants of concern at the Site, U-238 and Ra-226 and their associated progeny, are hazardous substances as defined in Section 101(14) of CERCLA, 42 U.S.C. § 9601(14) and 40 C.F.R. § 302.4, Appendix B. The following are the known health effects associated with exposure to the aforementioned hazardous substance on the Site.

## Uranium

Uranium is a widespread mineral-forming heavy metal that in nature is composed of three isotopes U-238, U-235, and U-234, with the U-238 isotope generally composing over 98% of the mixture. All of these isotopes are the same chemically, but they have different energy and decay properties. According to the ATSDR ToxFAQs for Uranium (October 1999) document, U is an alpha ionizing radiation emitter and in general, weakly radioactive. Exposure to excess levels of U can cause human tissue damage, primarily in the kidneys. Cancer risk from exposure to excess U levels appears to be low to none. The primary risk on this Site from U is cancer caused by exposure to the progeny generated by its decay.

## Radium-226

Radium-226 is principally a source of alpha and gamma radiation, although some beta radiation is also produced during the decay process. According to the ATSDR ToxFAQs for Radium (July 1999), exposure to Ra-226 can cause adverse effects to the eyes (cataracts) and blood (anemia). Radium-226 has been identified by the EPA and the National Academy of Sciences as a known human carcinogen, being specifically linked to cancers of the bone and breast, and leukemia.

Exposure pathways are the routes that a contaminant can take in order to be assimilated by a human or animal. For example, incidental ingestion of contaminated soils through direct contact or the inhalation of contaminated airborne particles (dust) are both exposure pathways. The exposure pathways of concern at the Site are described below:

The predominant exposure pathway related to Ra-226 was determined to be external gamma radiation. Preliminary results indicate that external gamma radiation contributes over 90% of exposure of the EPA Preliminary Remediation Guidance (PRG) site-specific modeled exposure scenario.

Approximately 20 acres (32%) of the surface area of this Site is contaminated with elevated concentrations of Ra-226 at or near the surface. All of the excess gamma radiation contamination appears to be located within one foot of the surface with the exception of the stockpiles footprint. Contamination in the stockpile areas is documented to be at least two feet below the surface. The contaminated soils are generally fine grained and have a high probability of adherence to skin, clothing and fur as a result of direct contact. For humans, incidental ingestion of the contaminants adhering to skin or clothing can occur through normal hand-to-mouth activities such as eating or play. This material can be transported by the wind and moved by water during heavy rain events.

Inhalation is another exposure pathway at this Site. A significant amount of the surface soils on this Site are contaminated with Ra-226. The contaminated soils tend to be fine grained and dusty, are easily

airborne after wind or mechanical disturbances, and are subject to inhalation by humans, livestock and indigenous wildlife. Inhalation and ingestion combined for a total of approximately 5% of the Total Effective Dose Equivalent estimate in modeled exposure scenario. (See Attachments 4, 5, and 6)

**B. Maps, Pictures and Other Graphic Presentations**

Attachment 1 - Site Location Map

Attachment 2 - Site Layout Map

Attachment 3 - Removal Site Evaluation Report TRONOX Navajo Area Uranium Mines Sections 32 and 33 Mines, Grants Mining District, Smith Lake Sub-District, McKinley County, New Mexico, Weston Solutions, Inc., July 2019

Attachment 4 - Removal Action Report Tronox AUM Section 32 Eastern Agency Prewitt, McKinley County, New Mexico, Ecology and Environment, Inc., February 2014

Attachment 5 - Request for Concurrence on Proposed Nationally Significant or Precedent-Setting Removal at Section 32 AUM Site, Casamero Lake Chapter, Navajo Nation Indian Reservation, McKinley County, New Mexico, Region 9 EPA, September 2012

Attachment 6 - Clifford, A. 2015. Biological Baseline Data and Geology of the Cove Region, Apache County, Arizona. Prepared for U.S. Environmental Protection Agency Region 9 Superfund Division.

**IV. THREAT TO PUBLIC HEALTH OR WELFARE OR THE ENVIRONMENT**

**A. Threats to Public Health**

Substances found at the Site, including the substances identified above in Section III. Nature and Extent of Contamination, constitute hazardous substances as defined by Section 101 (14) of CERCLA, 42 U.S.C. § 9601(14). Factors described in Section 300.415(b)(2) of the NCP have been considered and, based on those factors, a determination has been made that a removal action is appropriate to address the hazardous substances present in the contaminated wastes at the Site. Any or all of these factors may be present at a site yet any one of these factors may determine the appropriateness of a removal action.

- 1) Actual or potential exposure to nearby human populations, animals, or the food chain from hazardous substances or pollutants or contaminants. 40 CFR § 300.415(b)(2)(i).

The elevated concentrations of hazardous substances indicate that human exposure pathways exist through direct exposure to ionizing radiation, air (inhalation), direct contact (dermal), and soil (ingestion). Residents and their livestock utilizing the former uranium mining areas for grazing could be exposed to the contaminants. There is widespread evidence of utilization of the former mining areas by the residents and their livestock. There are now 19 people residing on Section 32 allotment land associated with the mine, and at least three other residential compounds associated with other allotments on Section 32, as well as evidence of grazing in the area, vehicle tracks, and spent ammunition casing.

The potential for exposure is elevated further because Site access is not fully restricted (e.g., the site is not fully fenced to prevent foot or vehicular access and there is limited signage warning not to trespass). Limited vegetative cover may result in the redistribution of contaminants throughout the surrounding environment. The stockpile from the Region 9 removal activities was secured with a chain link fence.



Ecological receptors, including avian, mammalian, and plant receptors, could become exposed to elevated site contaminants found in soils through direct contact with the contaminated materials and with water and sediments contaminated by the mine waste materials; ingestion of soils, water, and sediments contaminated by the mine waste materials; and ingestion of contaminated food (e.g., dust/sediment or soil-dwelling mammals/insects, or vegetation).

- 2) Weather conditions that may cause hazardous substances or pollutants or contaminants to migrate or be released. 40 CFR § 300.415(b)(2)(v).

As referenced above, the Site is located in McKinley County, in northwest New Mexico. This area routinely experiences severe weather of varying degrees of intensity during the Spring and Summer. Given that the referenced radiological contamination is located at or near the surface of the Site, and because the Site is located in a semi-arid area, with limited vegetative cover, there is a high potential for off-site migration of hazardous substances in surface soils from the Site via the flash flooding rains in the Summer and/or strong wind storms that are associated with strong low pressure systems in the Spring.

- 3) The availability of other appropriate federal or state response mechanisms to respond to the release. 40 CFR § 300.415 (b)(2)(vii).

At this time, there are no other mechanisms available to respond with the actions described in this memorandum in a timely manner so as to effectively reduce the imminent and substantial endangerment to public health posed by the hazardous substances located on the Site. The Navajo Nation and the State of New Mexico do not have the resources available to address the current human and ecological risks associated with the Site. If other mechanisms become available during the conduct of this response action, the EPA will evaluate those mechanisms as appropriate.

- 4) Other situations or factors that may pose threats to public health or welfare or the environment. 40 CFR § 300.415 (b)(2)(viii).

Traditional Ecological Knowledge (TEK) was provided by a Biological Baseline Data and Geology survey conducted by Navajo Geobotanist Arnold Clifford in 2014 to evaluate culturally significant types and uses of plants (See Attachment 6). Clifford notes that such native plants are referred to as “holy plant people” among the Navajo, suggesting that they are regarded as having intrinsic value and not just utilitarian worth. Clifford suggests a classification of plants by uses according to, “edible plants, medicinal plants, ceremonial plants, tobacco plants, utilitarian plants, dye plants, and plants for protection and for talisman.” With regard to specific species, he states that hundreds of plants are used as food sources and that there are approximately 300 plants within the medicinal plants category.

Potential activities that might be addressed in a TEK scenario include participation in sweat lodge ceremonies (water ingestion and inhalation exposures related to contaminated water and plant material), gathering of local plants, spinning wool and weaving, pottery, basket weaving, sand painting, and other traditional cultural practices that could result in ingestion, inhalation, dermal, or external exposures. Specific age groups for receptors may be applicable to different types of cultural uses. Clifford, A. 2015. Biological Baseline Data and Geology of the Cove Region. Apache County, Arizona. Prepared for US. Environmental Protection Agency Region 9 Superfund Division.

Based upon NCP factors (i), (v), (vii), and (viii), a current or potential threat exists to public health or welfare or the environment due to the release or threat of release of hazardous substances into the

environment. A non-time-critical removal action is therefore appropriate to abate, prevent, minimize, stabilize, mitigate, or eliminate such threats. A removal action is justified as opposed to a remedial action because there is a current completed exposure pathway that can be addressed more quickly via the removal process. This removal is designated as non-time critical because more than six months planning time is available before on-site activities must be initiated. Prior to the actual performance of a non-time critical removal at these Sites, Section 300.415(b)(4)(i) of the NCP requires that an EE/CA be performed in order to evaluate potential response options.

#### **B. Expected Change if No Action is Taken**

If no action is taken, or if action is delayed, excess gamma and other forms of ionizing radiation emanating from hazardous substances at or near the surface will remain as an actual or potential human health and/or environmental threat based on inhalation, direct contact, and ingestion pathways.

### **V. ENDANGERMENT DETERMINATION**

The actual or threatened release of hazardous substances within and from the Site may present an imminent and substantial endangerment to public health, welfare, or the environment within the meaning of Section 106(a) of CERCLA, 42 U.S.C. § 9606(a).

### **VI. ENFORCEMENT STRATEGY**

U.S. EPA anticipates that special account funding from the Tronox settlement summarized below will finance U.S. EPA's performance of the NTCRA for the Tronox NAUM Mine Site referenced in this memo. To the extent that this funding may be insufficient for implementation of the selected cleanup actions, U.S. EPA anticipates pursuing administrative and/or judicial enforcement to secure participation by other potentially responsible parties, if any.

On January 21, 2015, a settlement in the Tronox bankruptcy was finalized that provided almost \$1 billion to address approximately 50 mines on or near Navajo Nation lands ("Navajo Area Uranium Mines" or "NAUM"). Most of the Tronox mines not addressed in this memo are near the Navajo Nation and located in the State of New Mexico in U.S. EPA Region 6. These will be addressed in a future action memo. The approximately \$1 billion in funds the U.S. EPA received for the cleanup at the NAUM Sites has been deposited into U.S. EPA Superfund special accounts. In accordance with CERCLA Section 122(b)(3), special accounts are site-specific, interest-bearing sub-accounts housed within the U.S. EPA's Hazardous Substance Superfund Trust Fund. Charges to a special account must be consistent with the terms of the settlement pursuant to which the funds are received. Special account funds may be used for a wide range of CERCLA response actions.

### **VII. PROPOSED PROJECT AND COSTS**

The EE/CA will assist with defining the scope of the removal action. Based on the analysis of the nature and extent of contamination developed as part of the EE/CA, a limited number of removal action alternatives will be identified and evaluated against the scope of the removal action alternatives to meet the EPA cleanup objectives consistent with the Establishment of Cleanup Levels for CERCLA Sites with Radioactive Contamination, August 22, 1997 (OSWER Directive 9200.4-18) and the updated guidance, June 13, 2014 (OSWER Directive 9285.6-20). These directives establish a general, maximum



acceptable radiological dose level and an excess cancer risk value for excess radiation abatement activities on non-NRC licensed facilities.

The likely technology alternatives that will undergo detailed analysis include on-site containment, ex-situ solidification/stabilization, and off-site disposal, although others may be considered. Bench-scale treatability investigations may be conducted to gather sufficient data to allow the alternatives to be fully developed and evaluated, and to reduce cost and performance uncertainties so that a removal alternative can be selected.

When the EE/CA Report is developed, a 30-day public comment period will be announced. The EPA will address all comments received. The State of New Mexico, Navajo Nation and other stakeholder partners will receive a summary of the response alternatives prior to the public comment period. A removal alternative will be selected following public comment and evaluation.

The EPA RSE only evaluated the surface soils associated with this site and only contemplates addressing the actual or potential threats posed by the surficial contaminated soils/debris/waste materials associated with the Site. Groundwater or groundwater pathways were not addressed in the RSE because the mines associated are dry mines and there is no groundwater well on the Site. As referenced above in Section II. A, ore bodies associated with this mine are above any known water table and no viable pathways for potential contamination of any underlying groundwater are known to exist. Costs for conducting the EE/CA are approximately \$75,000.

## **VIII. RECOMMENDATION**

Conditions at the Tronox NAUM Sections 32 and 33 Mines Site in McKinley County, New Mexico meet the criteria in the National Oil and Hazardous Substances Pollution Contingency Plan, 40 CFR Part 300.415, for the initiation of a non-time-critical removal action. I recommend your approval to conduct an EE/CA.

## **IX. CONCURRENCE**

**JAMES WOOLFORD**

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James E. Woolford, Director  
Office of Superfund Remediation and Technology Innovation  
U.S. Environmental Protection Agency, Headquarters

**X. APPROVAL**

APPROVED: **KEVIN SHADE** Digitally signed by KEVIN SHADE  
DN: c=US, o=U.S. Government, ou=Environmental Protection  
Agency, cn=KEVIN SHADE,  
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Will C. Duncan III, Assistant Director  
Superfund and Emergency Management Division (SED)  
U.S. Environmental Protection Agency, Region 9

DATE: \_\_\_\_\_

Wren Stenger, Director  
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U.S. Environmental Protection Agency, Region 6